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ABSTRACT

Research assessed whether computer technology had altered aspects of the employee's control of his or her work environment. The general hypothesis was that computing would have enhanced control of work life in relation to other individuals and in relation to the job for employees higher in the organizational hierarchy who perform more discretionary information processing tasks. The hypothesis also proposed that computing would have diminished control of work life for employees lower in the hierarchy with less discretion. Data were derived from self-administered questionnaires completed by 1,448 municipal government employees who indicated they use the computer or receive computer-based information and have some interaction with those providing computing services. Computing had not yet caused dramatic effects on the work environment, but it had had notable effects on some aspects. Where computing had altered the employee's control in the work environment, the change tended to be job enhancing. Data in the analysis constituted a strong case against the general hypothesis. (YLB)

# COMPUTERS AND CONTROL IN THE WORK ENVIRONMENT

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# COMPUTERS AND CONTROL IN THE WORK ENVIRONMENT[1]

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The computer has become the essential symbol and perhaps the crucial driving force of "post-industrial" society. Despite the centrality of the computer, there is continuing disagreement regarding the overall impact of computers on social and personal life. On the one hand, the computer is presented as a technology whose protean applications will create an increasingly dehumanized and technocratic world. On the other hand, computer technology is credited with the capacity to produce goods and services with great efficiency and rationality, facilitating a life of abundance and leisure.

The work environment is a domain where major impacts from computer technology have been predicted. Yet our social-scientific knowledge of these impacts remains quite fragmentary. Thus this paper provides a systematic and empirical analysis of the impacts of computers on the work environment of selected types of white collar employees in one class of public organizations, municipal governments in the United States. Employing data gathered from a purposive sample of 1,448 employees in 42 governments, the analysis focuses upon two questions: (1) have computers substantially altered the employees' work environments?; and (2) do the impacts of computing on work vary significantly among different types of employees?

While there have been many hyperbolic claims about the impact of computers on the workplace, the effects that are empirically validated are rather more modest. The early empirical research (surveyed by Sartore and Kraemer, 1974) suggested that computing tended to reduce the quality of working life, particularly by producing greater time pressure and reducing individual satisfaction with the job (Hoos, 1961; Lee, 1966; Mann and Williams, 1958; Mumford

and Banks, 1967). The more recent empirical research (summarized by Kling, 1979) holds that, overall, computer technology has had limited rather than major impacts on the character of white collar working life: increasing job pressure, having little effect on the level of supervision experienced by the employee, and possibly resulting in moderate increases in job satisfaction (Kling, 1978; Stewart, 1972). It also seems that the patterns and levels of computer impacts on work vary across roles, with more positive (or less negative) impacts attributed to the computer as the employee's role ascends the organizational hierarchy from clerical workers to professionals and supervisors to managers (Dutton and Kraemer, 1978; Guthrie, 1974; Kling, 1978; Kraemer, 1980; Laudon, 1974; Mumford, 1972; Whisler, 1970).

## CONCEPTUALIZATION

The central focus of this research is to assess whether computer technology has altered aspects of the employee's control of his or her work environment. In our conceptualization, the linkage between the individual and the job can include control in relation to other individuals or in relation to the job itself. Thus we employ four variables that measure the effect of computing on the employee-work nexus: (1) control of the employee's work by others, as indicated by closeness of supervision; (2) the employee's control over others, as indicated by the capacity to influence others in the work environment; (3) the constraints imposed by the job itself on the employee's behavior, as indicated by time pressure in one's work; and (4) the employee's overall feeling of control over his or her work life, as indicated by sense of accomplishment on the job. The development of specific measures for these variables has been informed by core dimensions of the "Job Diagnostic Survey" (see Hackman and Oldham, 1975) as well as existing research on

computing in organizations. Our indicators for the measures are the employees' own assessments of whether these four aspects of control within their work environments have been affected by the computing systems with which they deal.

Given the possibility that the effects of computing on control of work-life might vary across types of employees, we distinguish five role-types from among the white-collar government personnel in our study. The role taxonomy is based on the employees' autonomy within the organizational hierarchy and on the dominant characteristics of their data-handling tasks. The five role types are: (1) managers, the top department-level administrators who mainly use summarized information from automated files on an occasional basis (primarily department heads and division heads in our sample); (2) staff professionals, the relatively professionalized groups who serve policy-makers and managers in a mainly staff capacity, analyzing data and providing information and advice (primarily planners, policy analysts, budget and management analysts, and accountants in our sample); (3) street-level bureaucrats, the line personnel who directly provide public goods and services to citizen-clients and who typically use specific information on a case-by-case basis (primarily police detectives and patrol officers in our sample); (4) desk-top bureaucrats, the staff employees who provide general administrative assistance to department and division heads and who are generators, manipulators and users of data on a constant basis (primarily administrative assistants and departmental monitors of resource allocations in our sample); and (5) counter-top bureaucrats, the employees in mainly clerical capacities who are extensively involved in recording, processing and searching information files for internal operations and/or for dealing directly with citizen-

clients (primarily traffic ticket clerks and records clerks in our sample). In general, these five role-types are listed in terms of decreasing autonomy within the organizational hierarchy and of increasing pervasiveness of data-handling responsibilities.

## HYPOTHESIZED RELATIONSHIPS

Most empirical research that has addressed the impact of computing on worklife has examined a particular role-type in a single organization or across a variety of organizations. Our research employs a systematic, comparative framework, undertaking both within-role and also between-role analyses for a large sample of individuals within a single class of organizations. Certain patterns of linkages between computing, employees and control of work suggested by existing research serve as our specific working hypotheses. These are briefly stated below and characterized in Table 1.

1. Computing will result in moderate increases in the supervision of work by others, particularly among those in what we term "bureaucratic" roles, where job performance involves less discretion, more routinization, and tasks whose quantity and accuracy are amenable to quantitative measurement.

2. Computing will result in differential changes in influence over others, with those roles lower in the organizational hierarchy experiencing relative decreases in influence as they lose their capacity to mediate the information flows to those in decision-making and supervisory roles, who will enjoy increased influence.

3. Computing will increase time pressure on those in more routinized and bureaucratic information-handling roles, especially desk-top bureaucrats and counter-top bureaucrats, and it will reduce time pressure on top managers and staff professionals who utilize aggregated and summarized data.

4. Computing will generally increase the overall sense of accomplishment with the job for those employees who have enjoyed increases in control over others and have avoided increases in control by others and time pressure--primarily managers and staff professionals, given our prior hypotheses.

[TABLE 1 ABOUT HERE]

As suggested by these specific hypotheses, we expect that the overall impact of computing on control of work life will be differentially distributed among role types. In general, computing will enhance control of work life in relation to other individuals and in relation to the job for those employees who are higher in the organizational hierarchy and who perform more discretionary information processing tasks (managers and staff professionals) while diminishing control of work life for employees lower in the hierarchy and with less discretion (those in "bureaucratic" roles).

## DATA AND METHODS

The data are primarily derived from lengthy self-administered questionnaires completed by a random sample of municipal government personnel in selected positions. Of the total sample in the data base, this paper examines the 1,448 employees who correspond to one of the five role-types specified above, who indicated that they use the computer or receive computer-based information, and who have had some interaction with those providing computing services. We analyze these employees because they are capable of providing the most informed responses regarding the impact of computing on their work environment. The employees are from 42 American municipal governments drawn in a sample stratified on key technological dimensions such as the

TABLE 1. HYPOTHESIZED RELATIONSHIPS BETWEEN COMPUTING AND CONTROL OF THE WORK ENVIRONMENT

| | Role | | | | |
|---|---|---|---|---|---|
| Computing Impact on | Managers | Staff Professionals | Street-level Bureaucrats | Desk-top Bureaucrats | Counter-top Bureaucrats |
| Level of Supervision | - | - | + | + | + |
| Influence over Others | + | + | - | - | - |
| Time Pressure | - | - | + | + | + |
| Sense of Accomplishment | + | + | - | - | - |

level of automation, the sophistication of hardware and software, and the level of centralization in the provision of computing.[2]

Initially, we present tabular analyses of the responses of the employees to specific questions regarding the impacts of computing on their work environment with respect to supervision, job pressure, influence over others, and sense of accomplishment. Then we assess whether there are significant between-role differences in the effects of computing on work, by means of Student's T test.

## FINDINGS

### Overall Impacts of Computing on Work Life

Table 2 indicates the percentage of employees in each role who attribute impacts on control in their work environment to computing. Several interesting generalizations can be derived from these data. First, the changes in work life caused by computing are widespread, but are not pervasive. Rather like descriptions of the half-full/empty glass of water, there are 11 instances where the majority of employees within a role report no change due to computing and there are nine instances where the majority have experienced a change. In fact, it is most accurate to reformulate this generalization to emphasize that the incidence of change caused by computing varies considerably with the nature of the work impact. On two of the four impact measures, the majority in each of the five roles have experienced no significant impact of computing on their work environment. The large majority in every role (72-85%) find that computing has not altered the extent to which their work is supervised and most (54-70%) indicate that computing has not affected their capacity to influence others. In contrast, a majority within each of the five roles does report a notable impact of computing on the sense of accomplishment

with their work and only the staff professionals (at 49%) fall below a majority among all roles in attributing changes in time pressure to computing.

[TABLE 2 ABOUT HERE]

It is intriguing that substantial majorities of employees, across all roles, report that computing has had no noticeable effect on supervision of their work or on their capacity to influence others. The images of the computer as an effective/pernicious device for careful and precise monitoring of work are prevalent from the early predictions about the impact of computers in organizations by Leavitt and Whisler (1958) to more recent ones by Pfeffer (1981). Why then has computing not altered the level of supervision of municipal personnel?

Our intensive case study fieldwork offers several explanations. While computing systems offer great potential for the collection of data on work performance that facilitate closer supervision, that potential has rarely been realized. For example, in situations where work was not monitored before automation, it tends not to be monitored after automation. When a new automated system is installed, managers have enough difficulty getting people to adopt and use the automated system, without adding objectionable monitoring features. Moreover, to this point there is an absence of computerized work monitoring systems with sufficient sensitivity to merit use. Finally, many superordinates are disinclined to place reliance upon automated data as opposed to other kinds of information personally gathered in their supervisory functions.

It is also unexpected that such a large proportion of those employees who use computing do not feel it has altered their capacity to influence others. Virtually all the literature on automated information systems predicts that

TABLE 2. EFFECTS ON WORK ENVIRONMENT ATTRIBUTED TO COMPUTING BY MUNICIPAL EMPLOYEES, BY ROLE[1]

| Computing Effect Upon: | Managers (N=498) | Staff Professionals (N=321) | Street-level Bureaucrats (N=343) | Desk-Top Bureaucrats (N=136) | Counter-Top Bureaucrats (N=150) |
|---|---|---|---|---|---|
| Supervision of work | | | | | |
| More closely supervised | 17% | 6% | 18% | 6% | 12% |
| No difference | 78 | 78 | 73 | 85 | 72 |
| Less closely supervised | 5 | 16 | 8 | 9 | 16 |
| Influence over others | | | | | |
| Less | 2 | 3 | 3 | 5 | 4 |
| No change | 56 | 54 | 68 | 64 | 70 |
| More | 42 | 43 | 30 | 31 | 26 |
| Time pressure | | | | | |
| Increased | 22 | 34 | 19 | 37 | 37 |
| Not affected | 48 | 51 | 36 | 42 | 38 |
| Decreased | 29 | 15 | 45 | 21 | 26 |
| Sense of accomplishment | | | | | |
| Lower | 4 | 3 | 5 | 5 | 7 |
| Not affected | 44 | 46 | 40 | 49 | 36 |
| Raised | 52 | 52 | 55 | 46 | 56 |

[1] Respondents are the 1,448 white collar employees in 42 American municipal governments who indicated that they use computers or receive computer-based reports and have had some contact with data processing personnel. Responses were on a self-administered questionnaire to these questions:

As a result of computing, is your work more or less closely supervised?
(less closely supervised, no difference, more closely supervised)

Has computing given you more or less influence over the actions of others?
(less influence, no change, more influence)

Has computing increased or decreased time pressures in your job?
(decreased, not affected, increased)

Has computing raised or lowered your sense of accomplishment in your work?
(lowered, not affected, raised)

All questions also had a "Don't Know" response.

these systems will importantly change the manner in which those in particular information-handling roles will access, manipulate, and utilize data and, as a consequence, that automated systems will lead to what Anthony Downs (1967) termed "power shifts." The data actually do suggest a pattern of differential effects of computing on influence, a set of effects we shall explore more fully when we examine between-role differences below.

The second broad generalization that emerges from Table 2 is that the effects of computing on work life are largely job-enhancing. This is most evident on the overall measure of the impact of computing on the employee's sense of accomplishment. About half of those in every role find that computing has raised their sense of accomplishment on their job, while most of the rest indicate that computing has had no effect. Similarly, while the majority in every role report that computer technology has not altered their capacity to influence others, nearly all those who have experienced an impact report that they have greater influence due to computing, ranging from 26% to 43% across the roles. Less than one in five employees in any role reports that computing has increased the level of supervision of their work. And even the impact of the computer on time pressure has been generally benign, with 63% to 81% reporting that computing either has not affected or has actually decreased the pressure they experience on the job. Overall, there is little support in these general measures for the view that computer technology, at least in its current modes of implementation and use, has been a dehumanizing or demoralizing force in the work life of white collar employees.

## Between-Role Differences in Impacts of Computing on Work Life

A fuller understanding of these data on computers and the work environment can be achieved by an analysis of the between-role variations. While

Table 2 is useful, Table 3 adds precision to the assessment, providing a measure of the between-group variations that are statistically significant, as determined by Student's T-test. Table 3 indicates all those instances where the distribution of effects attributed to computing by any two roles are significantly different and it also identifies the role that has experienced the greater increase.

[TABLE 3 ABOUT HERE]

The first major finding in Table 3 is that the sense of accomplishment variable is not listed. Thus there are no significant differences between any two roles in the extent to which computing has altered municipal employees' overall feeling of mastery of work. The second major finding is that computer technology produces quite substantial differential effects across roles on most aspects of control in the work environment examined in the analysis. Of the ten possible role pairings, there are significant between-role differences in seven instances regarding time pressure, and in six instances regarding both supervision and influence over others. The subsequent paragraphs characterize these differences.

Supervision

Although the majority of employees in all roles indicate (in Table 2) that computers have not affected the level of supervision of their work, Table 3 reveals that there are many statistically significant between-role differences regarding this impact of computing. It is typically assumed that the capabilities of automated systems are best suited to provide work-monitoring data and supervisorial control over those whose work has standardized outputs amenable to quantitative measures of workload and accuracy. Among our roles, this characterization would seem to fit best the desk-top bureaucrats

TABLE 3. SIGNIFICANT BETWEEN-ROLE DIFFERENCES IN EFFECTS ON WORK ENVIRONMENT ATTRIBUTED TO COMPUTING[1]

| | Staff Professionals | Desk-top Bureaucrats | Counter-top Bureaucrats | Street-level Bureaucrats |
|---|---|---|---|---|
| Managers | Time Pressure*** [2]<br>Supervision*** - | Time Pressure** ←<br>Supervision*** -<br>Influence** - | Time Pressure* ←<br>Supervision** -<br>Influence*** - | Time Pressure*** -<br>Influence*** - |
| Staff Professionals | | Influence* - | Influence** - | Time Pressure*** -<br>Supervision*** ←<br>Influence** - |
| Desk-Top Bureaucrats | | | | Time Pressure*** -<br>Supervision** ← |
| Counter-Top Bureaucrats | | | | Time Pressure*** -<br>Supervision** ← |

1 Table indicates only those role pairings where the between-group difference determined by Student's T-test is significant, using appropriate variance estimates for two-tailed probability.
* < .05
** < .01
*** < .001

2 Arrow indicates the role with higher mean score on the indicator.

and counter-top bureaucrats, secondarily the street-level bureaucrats, whose work involves more discretionary action in the field, and least the staff professionals and managers, whose work is least routine and least measurable by objective indicators.

However, in a quite unexpected pattern, Table 3 reveals that staff professionals, desk-top bureaucrats and counter-top bureaucrats are differentiated from managers and street-level bureaucrats. Moreover, the former roles tend to experience less close supervision and the latter roles tend to experience closer supervision as a result of computing. While the data for staff professionals and street-level bureaucrats correspond generally to the pattern of effects on supervision hypothesized above, there is no obvious explanation why those in the two most routinized and continuous information-handling roles find that computing tends to reduce the level of supervision over their work or why managers indicate that computing tends to increase supervision over their work.

Our rationales for these surprising findings are admittedly speculative. Perhaps employees in relatively routinized information-processing work find that computerized systems now handle some of the more mechanical aspects of their work, freeing them from troublesome problems and minimizing their data-handling errors, thereby reducing the need for close supervision of their work and, possibly, increasing the proportion of their time allocated to more discretionary activities. There is some support for this explanation in a recent study of traffic-ticket processing in cities. Kraemer, Dutton and Northrop (1981) found that automation enabled the staff in traffic agencies to better meet legally prescribed time periods for ticket-processing, minimize the backlog of tickets to be processed, increase the difficulty of "fixing" tickets, and improve the accuracy of handling tickets while also increasing

their ability to provide discretionary services, such as sending reminder/delinquent notices to citizens. And perhaps managers experience increased supervision primarily in the sense that automated financial systems have substantially increased centralized monitoring and control over departmental use of resources, rather than in the sense that superordinates or peers have greater supervisorial control over their general managerial functions. Support for this explanation is provided by Markus's (1979) study of a financial information system in a multi-divisional corporation, where a new system gave corporate managers greater control over divisional expenditures.

Influence

Table 3 also provides useful data for further assessing the notion that power shifts are caused by computing through altering some employees' influence over the actions of others. While no more than one in 20 employees in any role felt (in Table 2) that they had less influence over others due to the impacts of computing, Table 3 indicates that on six of the ten role pairings there are significant between-role differences in the effects of computing on individuals' influence. Both managers and staff professionals have enjoyed relatively greater increases in influence attributable to computing than have those in any of the three categories we have classified in "bureaucratic" roles.

This clustering of the managers and staff professionals, on the one hand, and the bureaucratic roles, on the other, does seem to offer support for the power shift hypothesis in the sense that those higher in the organizational hierarchy and those in more policy-oriented roles seem to credit computing with affording them the greatest increases in influence (see Danziger et al., 1982; Dutton and Kraemer, 1977; Kraemer, 1980). But a problem with treating these data as unambiguous support for the "pure" form of the power shift

hypothesis is that power is normally viewed as a zero-sum phenomenon, and yet few employees in any role report that computing has reduced their influence. It might be that the power "losers" are in roles other than those in our analysis, or that the losers do not recognize their loss. An alternative interpretation is that we measure influence, which is a form of power that need not be zero-sum (Neumann, 1950). From this perspective, computing has essentially been influence-enhancing when it has had any notable effect, especially for those in more discretionary, policy-oriented roles.

Time Pressure

The time pressure variable is particularly interesting because both Table 2 and Table 3 indicate that this is the dimension of work life where the effects of computing exhibit the greatest variation across roles. Table 2 indicated that in all five roles there is a split between those who experience increased and reduced job pressure due to computing. Although changes in time pressure are most prevalent among those in the three bureaucratic roles, the directions of changes are not fully consistent with our hypothesis. It is staff professionals, as well as desk-top and counter-top bureaucrats, who report increased pressure rather than decreased pressure, by ratios of about 2:1. As hypothesized, managers are more likely to report decreased time pressure, but the street-level bureaucrats experienced the highest incidence of decreased pressure, by a ratio of more than 2:1.

Table 3 clearly reinforces these observations. Street-level bureaucrats report computing effects on time pressure that tend toward decreased pressure substantially more than any other role, as indicated by the highly significant T-test probabilities in every case. And similarly, managers reflect a pattern toward decreased job pressure that is significantly different from that of

the three remaining role-types. One can, of course, reverse this characterization, observing that desk-top bureaucrats, counter-top bureaucrats and staff professionals experience effects from computing that tend to increase time pressure much more frequently than street-level bureaucrats and managers.

What might explain this particular pattern of effects of computing on time pressure? Our fieldwork suggests that the explanation lies in the dominant styles of data-handling that characterize the different roles. The incidence of increased job pressure is higher for those roles that are extensively, directly, and frequently involved in both the use and also the generation and manipulation of considerable amounts of data amenable to automation. This is especially the case for counter-top and desk-top bureaucrats, whose work activities are dominated by data-handling and who are likely to have substantial "hands-on" involvement with computers and computer-generated data. Staff professionals such as planners and policy analysts also tend to operate in these multiple modes of constant data-handling. Thus if one's job involves substantial generation and manipulation as well as utilization of information, direct involvement with computing dramatically increases the scope and scale of one's information-handling milieu and, as a consequence, the job pressure one experiences. And the regular, direct interface with computing, which has its own rhythms of demands and responses, might also contribute to these time pressures.

In contrast, both managers and street-level bureaucrats are primarily users rather than generators of information in computing systems. They tend to use automated information indirectly (that is, their use of computing is mediated by others) and occasionally, (that is, on a periodic or case-by-case basis). For example, the patrol officers who comprise part of the street-level bureaucrats in our sample require simple, standard and rapid fact retrieval

in response to field incidents such as a speeding or drunken driver. Their main use of computing is to obtain specific information by radio from headquarters dispatch staff who search computerized files for them. Since patrol officers can detain citizens a limited time, the rapid response provided through a computerized information system can actually decrease the time pressures that officers feel (Kraemer, Dutton and Northrop, 1981). Thus if one's job primarily involves the occasional use of automated information but not its continual generation and manipulation, and if involvement with computing tends to be indirect, it is likely that one will credit computing with decreasing job pressure.

## DISCUSSION AND CONCLUSIONS

In assessing the array of data and findings above, several general conclusions are quite apparent. The first overall conclusion is that, for the public employees in our analysis, computing has not yet caused the kinds of dramatic impacts on the work environment that have been suggested in the mildly empirical analyses that informed our study. In Table 2, the modal response was no change/no effect attributed to computing in 15 of the 20 pairings of a role with a feature of the work environment. In fact, the majority in every role reports no change due to computing on the key issues of control of work by others and control over others in the work environment. And the modal response on the effect of computing on time pressure is no change for every role except street-level bureaucrats.

But a second general conclusion, qualifying the first one, is that computing has had notable effects on some aspects of the work environment. The majority of those in all five roles have experienced a change they attribute to computing in their sense of accomplishment with work, and a

majority in four of the five roles report such changes on time pressure. Substantial minorities in several roles also report that computing has altered their capacity to influence others. Finally, a third general conclusion is that where computing has altered the employee's control in the work environment, the change tends to be job-enhancing. In 15 of the 20 cases, the proportion within a role experiencing a favorable change due to computing is greater than the proportion reporting a negative effect.

When we consider the working hypotheses summarized in Table 1, we find that the data in this analysis constitute a strong case against those hypotheses. That is, if the positive and negative signs in the table imply that a majority of those within the given role would attribute to computing the particular change in the work environment, the predictions in the table are supported (by the data in Table 2) in only two of twenty cases--namely, computing results in a greater sense of accomplishment with work for the majority of managers and staff professionals. Moreover, even if we examine only those employees who report that computing has altered a particular aspect of their work life, our initial expectations about the direction of the effect of computing are supported by the data in only 9 of 20 cases.

Since Table 1 was informed by the existing research, what might account for the variance between our expectations and reality? One might argue that the flaws are inherent in our sample or methodology, although we believe this explanation is unsupported. We are more sympathetic to the notion that the existing research does not provide a strong basis for generating hypotheses, since it is rarely characterized by systematic and empirical comparative analysis. Indeed, that research and the conventional wisdom resulted in several assumptions that were not supported by our analysis.

First, we assumed that the impacts on work would vary considerably across roles, with some roles experiencing quite positive effects from computing and others experiencing negative effects. As we have noted, this was true for the measures of supervision and time pressure, where changes were positive for some roles and negative for others; but it was not true for the measures of influence and sense of accomplishment, where all five roles indicated that changes were essentially positive. Secondly, we assumed that the pattern of directionality in the changes would be hierarchical, in the sense that the distribution of effects from computing would be Likert-like, scaling from those roles higher in the organization and with greater job discretion to those roles lower in the organization and with less job discretion. In fact, the data in Table 3 provide a strong case that there are clusters of roles within which rather similar patterns of effects from computing are reported. Moreover, these clusters are composed of different roles on different aspects of control in the work environment. These varying clusters were characterized for each aspect of control in the work environment in our explication of Table 3. Is there an underlying structure in these intriguing and somewhat surprising patterns of effects of computing on the work environment?

While the absolute levels of computing effects on control in the work environment serve as the base for discussing this question, we stress the relative effects between roles in order to focus attention on the differential impacts of computing on work. Two different clusters of roles emerged in the between-role analyses in Table 3. When the issue is the employee's control over others, as measured by the level of influence, managers and staff professionals enjoyed greater increases in control attibuted to computing than did those in any of the three "bureaucratic" roles. However, when the issue

is the control of the employee by others, as measured by the level of supervision, or when the issue is control by the work context itself, as measured by time pressure, the impacts of computing on managers and street-level bureaucrats are similar and vary significantly from the impacts of computing on staff professionals, counter-top bureaucrats and desk-top bureaucrats. Broadly, the latter three roles experienced relatively less supervision due to computing and relatively greater time pressure due to computing than did those in the former roles.

Table 4 displays this pattern of relative effects of computing on work for the five roles. Broadly, it shows that one dynamic seems to account for the effects of computing on influence and another for its effects on supervision and time pressure. The configuration of similar roles on influence over others is generally consistent with our initial notion that the effects of computing on control of work would be contingent on the role's level in the organizational hierarchy. Moreover, this is the one case where the pattern hypothesized in Table 1 is at least loosely confirmed. We infer that those in roles lower in the hierarchy do experience relative decreases in influence as they lose their capacity to mediate information flows to superordinates, and those in higher-level roles gain influence as computerized systems increase their capabilities for accessing and analyzing data relevant to organizational analysis and decision-making. With regard to changes in influence, it should be recalled that few in any role reported that computing had actually reduced their control over others. Thus we have argued that computing seems to expand the influence "pie" or, at least, it seems to approximate a Pareto optimal situation where some perceive they are better off and few/none perceive they are worse off. But it is also clear that computing has particularly enhanced the control over others of those already in positions higher

in the organizational hierarchy, lending some support to the view that computing is a power-reinforcing technology (Danziger, Dutton, Kling, and Kraemer, 1982).

[TABLE 4 ABOUT HERE]

To account for the role clusters on supervision and time pressure, Table 4 suggests that a second dimension of each role might be crucial. This dimension focuses upon key characteristics of the dominant data-handling responsibilities associated with the role. Our earlier explanations of why these role clusters emerged on supervision and time pressure tended to emphasize the different patterns of data-handling in each cluster. Managers and street-level bureaucrats tend primarily to be users of the kinds of data amenable to automation, tend to use such data on an intermittent or case-by-case basis, and tend to gain access to such automated data through intermediaries. In contrast, such data-handling for staff professionals, counter-top bureaucrats and desk-top bureaucrats is likely to be far more pervasive in their work. These roles tend to be not only users but also generators and manipulators of the kinds of data in automated systems, they tend to work directly with computers and computer-based data, and such data-handling is a continual feature of their work.

The effects of computing on time pressure are substantial and are also quite variable across roles. And again, the pervasiveness of data-handling in an employee's work is quite useful in understanding the role clusters regarding computing and time pressure. As we noted above, computing systems are an increasingly crucial force in the work environment of those for whom data-handling is a pervasive job characteristic. The technology can affect and even control the scale and rate of information-processing demands and

TABLE 4. SUMMARY OF FINDINGS ABOUT RELATIVE IMPACTS OF COMPUTING ON CONTROL OF WORK

| Autonomy in the organization's hierarchy | Pervasiveness of data-handling in work[1]: High | Low | Impacts[2] |
|---|---|---|---|
| High | Staff Professionals | Managers | + Influence |
| Low | Counter-top bureaucrats and Desk-top bureaucrats | Street-level bureaucrats | - Influence |
| Impacts[2] | - Supervision<br>+ Time pressure | + Supervision<br>- Time pressure | |

1 High means that data-handling tends to be direct, multi-modal, and continual; low means that data-handling tends to be indirect, use-oriented (relative to generation and manipulation), and intermittent.

2 Impacts are those effects on control of work attributed to computers. The table indicates those roles which have experienced an impact in a significantly different pattern than the roles with which it is contrasted.

pressures on the employee. Continual and multi-modal data-handling responsibilities as well as direct involvement with computing are all important factors regarding the job pressures generated by automated information systems. In contrast, managers and street-level bureaucrats in the field tend to be buffered from the pressures resulting from continuous and direct involvement with computers; rather they tend to enjoy mainly the job benefits from requesting and receiving from others the timely and relevant information they desire from automated systems.

The data-handling characteristics of the different roles also provide a partial explanation for the role clusters on the effects of computing on work supervision (although it is important to note that the majority in every role indicate that computing has not altered the level of supervision of their work). Since the work of those in roles where data-handling is more pervasive, particularly the desk-top and counter-top bureaucrats, seems most suited to automated work monitoring systems, it is surprising that these groups were more likely to experience reduced supervision due to computing than managers or street-level bureaucrats. We suggested that for those whose work is high in data-handling there are computerized systems that can fulfill many of the routine calculating, printing and record-keeping tasks which previously required particularly close supervision regarding accuracy and speed. Indeed, by automating such tasks, computing might reduce not only the closeness of supervision required, but also the proportion of the employee's work time devoted to the non-discretionary activities where supervision is appropriate. Ironically, it is possible that computing might result in the greatest increases in supervision of those whose work was traditionally insulated from effective data-based monitoring. The relevant examples for our analysis are the role of computing in the supervision of managers by centralized controllers

using the data in automated resource utilization systems and the capture and analysis in computerized systems of performance data about street-level bureaucrats whose work was previously buffered from direct supervision because it occurred in the "field."

In assessing the "net" effects of computing on control for each role, Table 4 illuminates the fact that no single role has uniformly gained greater control over the work environment as a result of computing. Clearly, the employees in each role have experienced a mix of positive, neutral and negative control impacts. But the table does suggest that computing has particularly benefitted the staff professionals on the most crucial components of control in the work place. Staff professionals are the only group who have enjoyed both relative increases in their control over others and also relative decreases in the level of supervision of their work. The data on the impacts of computing in Table 2 are consistent with this interpretation that staff professionals have enjoyed the greatest control benefits. Staff professionals credited computing with more favorable effects on sense of accomplishment than any other role, they reported the lowest level of increased supervision of any role, and they were the role where the highest percentage attributed increases in influence to computing. Only in terms of increased time pressure did staff professionals report a net negative effect from computing.

These beneficial effects of computing for staff professionals regarding control over others and control by others are in accord with the prediction by Downs (1967) and Lowi (1972) that an "information elite" would gain increased control from the expanding use of computers within the organization. The "information elite" combines a high level of technical expertise in their organizational domain with some sophistication in the use of computers and/or computer-based information. Given their organizational position at the center

of the policy process, these capabilities enable the information elite to influence, and possibly even to dominate, the nature of policy definition, policy formation, and policy implementation (Danziger, Dutton, Kling and Kraemer, 1982).

The information elite in our sample is primarily composed of such municipal employees as policy analysts, planners, and high-level management and budget analysts. These groups of technically skilled specialists provide increasingly sophisticated information services to the organization. Although they are dispersed among different organizational subunits, they tend to share basic norms regarding professional standards of practice and the role that technical expertise ought to play in guiding decisions and actions. Staff professionals, as an information elite, are particularly likely to gain increased control as the role of computing expands within the work environment because this elite serves as the effective broker between the computer elite who provide data processing services and the policy-makers and managers who need to tap the extensive capabilities of automated information systems. The information elite gains control over others (influence) and resists control by others (supervision) by a combination of persuading others through the force of their data- and information-based arguments and of serving others as an effective information broker whose competencies are essential.

These findings regarding staff professionals seem especially significant because they are one of the first (if partial) confirmations in a systematic, empirical analysis of the prediction that computer technology will enable an information elite to reap the greatest increases in control within organizations. It is possible that, over time, the spread of computer literacy and of "user-friendly" computer systems will reduce the relative advantages of the information elite. But the advantages of this elite in the near-future seem

considerable, and they might continue for quite a long period. Consequently, empirical research on the distribution of control within organizations and on the rise of technocratic elites might well focus on the nature of information elites. In particular, it is important to determine whose interests and agenda will be best served by the actions of the information elite.

## NOTES

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2. Our analysis of the 42 cities was part of an extensive, multi-phase research project. On the basis of a first phase survey of all American municipalities with population greater than 50,000, the 42 were selected for intensive field research. The selection was guided by the objective of analyzing alternative configurations on key aspects of the provision of computer technology. A variation of a disproportionate stratified sampling technique was employed, locating each of the 403 municipalities in the appropriate cell of a 64 cell partitioned sample based on six dichotomized variables measuring computing provision. The individual municipalities for field research were selected randomly from within a balanced set (on the six variables) of 40 strata. This strategy is described fully in Kraemer et al., (1981). For the purposes of this analysis, the cities are somewhat more "developed" with regard to computing than a purely random sample of cities, circa 1975. Given computing expansion and evolution in the subsequent period, the local governments we studied are not untypical of most such governments today.

During the one to six person-weeks of field research in each of the 42 sites, we undertook multiple data-gathering strategies including numerous interviews, collection of objective measures of the government and the computing environments, and the distribution of 50-100 lengthy self-administered questionnaires to potential users of computer services. Respondents were selected initially on the basis of certain roles in the government that would

cover all seven "information processing tasks" which might be automated (see Danziger et al., 1982: Appendix). Specific respondents were selected randomly from lists of all employees within the given role. Of 3,222 questionnaires distributed, the overall response rate was 82%. In this paper, we have analyzed that set of the respondents who met the crucial criteria for our research interests: (1) being classified in one of the five role-types upon which we focus; (2) reporting that they have used computers or computer-based information and that they have had some contact with data processing personnel. Appendix 1 indicates the respondents in each role-type in our analysis. For a complete discussion of the methodology of the URBIS Project, see Kraemer et al., (1981) or Danziger et al., (1982).

REFERENCES

Danziger, James N., William H. Dutton, Rob Kling and Kenneth L. Kraemer (1982) Computers and Politics: High Technology in American Local Governments. New York: Columbia University Press.

Downs, Anthony (1967) "A Realistic Look at the Payoff from Urban Data Systems," Public Administration Review 27(3): 204-210.

Dutton, William H. and Kenneth L. Kraemer (1977) "Technology and Urban Management: The Power Payoffs of Computing," Administration and Society 9(3): 304-340.

Guthrie, Art (1974) "Attitudes of the User-Managers towards Management Information Systems," Management Informatics 3(5): 221-232.

Hackman, Richard and Greg Oldham (1975) "Development of the Job Diagnostic Survey," Journal of Applied Psychology 60(2): 159-170.

Hoos, Ida (1960) "When the Computer Takes over the Office," Harvard Business Review 38: 102-112.

Kling, Rob (1978) "The Impacts of Computing on the Work of Managers, Data Analysts and Clerks," Irvine, CA: Public Policy Research Organization.

Kling, Rob (1979) "Social Analyses of Computing: Theoretical Perspectives in Recent Empirical Research," Computing Surveys 12(1): 61-110.

Kraemer, Kenneth L. (1980) "Computers, Information, and Power in Local Governments," in A. Moshowitz (ed.), Human Choice and Computers 2: 212-235.

Kraemer, Kenneth L., William H. Dutton and Alana Northrop (1981) The Management of Information Systems. New York: Columbia University Press.

Laudon, Kenneth C. (1974) Computers and Bureaucratic Reform. New York: Wiley.

Leavitt, Harold J. and Thomas L. Whisler (1958) "Management in the 1980's," Harvard Business Review 36(6): 41-48.

Lee, H. C. "Electronic Data Processing and Skill Requirements," Personnel Administration 29(3): 365-370.

Lowi, Theodore (1972) "Government and Politics: Blurring of Sector Lines," in Information Technology: Some Critical Implications. New York: The Conference Board.

Mann, Floyd C. and Lawrence K. Williams (1958) "Organizational Impact of White Collar Automation," Annual Proceedings of Industrial Relations Research Associates: 59-68.

Markus, M. Lynne (1979) Understanding Information System Use in Organizations: A Theoretical Approach. Unpublished Ph.D. dissertation. Cleveland, OH: Case Western Reserve.

Mumford, Enid (1972) Job Satisfaction. London: Longmans.

Mumford, Enid and O. Banks (1967) The Computer and the Clerk. London: Routledge & Kegan Paul.

Neumann, Franz (1950) "Approaches to the Study of Political Power," Political Science Quarterly 65(2): 162-188.

Pfeffer, Jeffrey (1981) Power in Organizations. Marshfield, MA: Pitman Publishing Co.

Sartore, AnnaBelle and Kenneth L. Kraemer (1974) Automation, Work and Manpower Policy. Irvine, CA: Public Policy Research Organization.

Stewart, Rosemary (1971) How Computers Affect Management. Cambridge, MA: MIT Press.

Whisler, Thomas (1970) The Impact of Computers on Organizations. New York: Praeger.